-continued

$$N = \sum_i \frac{R_i}{R_{min}} \frac{QOS_i}{QOS_{min}} n_i$$

In the above equations, each

$$\left(\frac{R_i}{R_{min}} \frac{QOS_i}{QOS_{min}} n_i \right)$$

value is a population share N_i for devices or type i. Each

$$\left(\frac{R_i}{R_{min}} \frac{QOS_i}{QOS_{min}} k_i \right)$$

value is a current load share value for devices of type i. The sum or the populations shares (N_i, N_{i+1} . . .) equals the equivalent population N_i. The sum of the current load shares (K_i, K_{i+1} . . .) equals the equivalent current load. The equivalent current load value, K, and equivalent population value, N, calculations are based on the principal that wireless devices with higher data rates and/or higher quality of service requirements effectively act as a proportionately higher number of wireless devices by taking up a larger amount of the available power.

The processor **376** sends the parameters K and N via the output **378** and the conductor **380** to the input **382** of the processor **384**. The processor **384** then determines the probability of transmission values for the wireless devices, such as the wireless device **172** of FIG. **5**, from the principle that the expected value of the equivalent current load at a time t+T, K_{exp}, should be less than F. The expected value of the equivalent current load at a time t+T is preferably estimated based on the equivalent current load K at time t and a doubly stochastic Poisson probability function.

For a base station servicing wireless devices with the same data rate and the same quality of service requirement the following equation is used:

$$K_{exp} \leqq F$$

or

$$(N-K)(1e^{-T/\tau_0})P_t + K^{T/\tau_1} P_{tt} \leqq F.$$

The expression on the left of the "≦" sign represents K_{exp} at time t+T. The expression (N−K) $(1-e^{-T/\tau_0})$ P_t represents the equivalent number of wireless devices which were not active but which will become active after time delay T. T is the roundtrip time delay from transmission of a data signal from an active wireless device to reporting that transmission to another wireless device. The expression K^{-T/τ_1} P_K represents the equivalent number of wireless devices which were transmitting and will continue to transmit after time delay T. P_t is the probability of a new transmission and P_K is the probability of continuing an ongoing transmission. The expression (N−K) represents the equivalent number of wireless devices which are not currently transmitting. K represents the equivalent number of wireless devices which are transmitting at time t. The expression $(1-e^{-T/\tau_0})$ represents the stochastic probability function that an inactive user will become active after time delay T. The expression e^{-T/τ_1} represents the stochastic probability function that an active user will stay active after the time delay T. F is again the spreading ratio of the bandwidth of the uplink frequency channel divided by the minimum data rate.

If it is assumed that P_t is equal to P_K then P_t and P_K can be solved for in the previous equation. P_t can also be assumed to be a fraction of P_K so that a priority is given to ongoing transmissions. In either case, P_t and subsequently P_K can be solved for known N, K, the time constants τ_0 and τ_1, and the time delay T.

The previous equation uses a doubly stochastic model for a wireless device which is transmitting as a bursty packetized source. The source is either in an ON state where packets are being transmitted to a base station or an OFF state when they are not. The probability of staying in the ON state after a particular time delay T is e^{-T/τ_1} and the probability of changing from the ON state to the OFF state in time delay T is $1-e^{-T/\tau_1}$. The probability of staying in the OFF state after time delay T is e^{-T/τ_0} and the probability of changing from the ON state to the OFF state is $1-e^{-T/\tau_0}$. Other modelling functions can be used to model the activity/inactivity of a wireless device. The ratio of the average ON time of a wireless device to the sum of the average ON time and the average OFF time is generally known as the activity factor, β_i. For this model, $\beta_i = \tau_1/(\tau_i + \tau_0)$.

For a system comprising wireless devices with two different data rates or QOS requirements, the following expression can be derived, again using a doubly stochastic Poisson probability function:

$$K_{exp} \leqq F$$

or

$$(N_1 - K_1)(1 - e^{-T/\tau 10})P_{t1} + K_1 e^{-T/\tau 11} P_{tt1} +$$

$$\frac{R_2}{R_1} \frac{QOS_2}{QOS_1} [(N_2 - K_2)(1 - e^{-T/\tau 20})P_{t2} + K_2 e^{-T/\tau 32} P_{tt2}] \leqq F.$$

The expression on the left side of the "≦" sign represents K_{exp} at time t+T. N_1 and N_2 represent population shares for wireless devices with a first and second data rate, respectively. K_1 and K_2 represent current load shares for wireless devices with a first and second data rate, respectively. P_{t1} and P_{K1}, represent probabilities of new transmission and ongoing transmission, respectively, for devices with the first data rate. P_{t2} and P_{K2} represent probabilities of transmission for devices with the second rate.

The equation above can be simplified by making the following assumptions:

$$\tau_1 = \max\{\tau_{11}, \tau_{21}\}$$

$$\tau_0 = \min\{\tau_{10}, \tau_{20}\}.$$

For a system with more than two types of wireless devices, the appropriate equation can be simplified by the following assumptions:

$$\tau_1 = {}^{max}i\{\tau_{i1}\}$$

$$\tau_0 = {}^{min}i\{\tau_{i0}\}.$$

With these assumptions it is possible to send only the parameters K and N to wireless devices and allow those wireless devices to calculate their own probability of transmission value. Otherwise, all current load shares (K_i, K_{i+1} . . .) and population shares (N_i, N_{i+1} . . .) should be transmitted to the wireless devices if the probability of transmission value calculation is to be determined distributively at the wireless devices.